

Berlin, 14.12.2004
GZ 26 1178-PCT/US/04

Applicant/Inventor:
Oliver Völckers
Im Kirschengarten 26
D-54294 Trier

Patent Claims

1. Device for detecting a mechanical actuation of an input element, that is spring-suspended in one plane and is from this level actuatable both in a vertical direction as well as in a direction that is diagonal to the vertical at a specified angle to the vertical axis, comprising a switch element (18; 15) converting the motions subjected onto the input element (11) into electrical, digital signals, and a control module (16; 17) working on the basis of pattern recognition that translates the electrical signals supplied from the switch element (18; 15) are provided, wherein the switch element (18; 15) exhibits a multitude of contact pairs (142; 143; 143; 145; 151) of the contact matrix (15) that can be closed arbitrarily depending on the position of the input element (11).
2. Device according to claim 1, wherein the switch element (12; 15) consists of a base plate (14) placed underneath the input element (11) that exhibits a contact matrix (15) equipped with contacts (142; 143;

144; 145; 151) and the input element (11) exhibits a calotte (12) on its underside (19) that exhibits an electrically conductive contact coating (18) on its convex surfaces opposite to the underside (19).

3. Device according to claims 1 and 2, wherein the calotte (12) consists of a deformable material, mainly an elastomer.
4. Device according to claims 1 to 3, wherein the calotte (12) exhibits a flat area in its center with a surface stretching parallel to the underside (19) of the input element (11) and a bevel at its edges.
5. Device according to claims 1 to 4, wherein the contact matrix (15) exhibits a multitude of contacts (142; 143; 144; 145; 151) along one axis.
6. Device according to claims 1 to 5, wherein the contact matrix exhibits a two-dimensional contact allocation.
7. Device according to claims 1 to 6, wherein the calotte (12) exhibits a profile of a polygone shape with no

more than ten edges (234; 235) that corresponds to the underside (19) of the input element (11).

8. Device according to claims 1 to 6, wherein the calotte (12) exhibits a circular shape.
9. Device according to claims 1 to 8, wherein the contacts (142; 143; 144; 145; 151) of the contact matrix (15) are arranged in pairs of an alternating sequence.
10. Device according to claims 1 to 8, wherein the contacts (142; 143; 144; 145; 151) of the contact matrix (15) are arranged coaxial to each other in an alternating sequence.
11. Device according to claims 1 to 8, wherein the contacts (142; 143; 144; 145; 151) of the contact matrix (15) are arranged in a cross-over sequence.
12. Device according to claims 1 to 8, wherein a flexible foil (251) is provided underneath the input element (11) between the calotte (12) and the contact matrix (15) with a convex curvature (252) that is flexibly

manoeuvrable into the direction of the input element (11) and is equipped with an electrical conductive coating (253) at its underside in the area of the contact matrix (15).

13. Device according to claims 1 to 8, wherein the input element (11) is shaped as a joystick and flexibly mounted underneath a case cover (261), the calotte (12) having a convex shape.
14. Device according to claims 1 to 8, wherein the input element (11) is mounted flexibly opposite to the base plate (14) within the casing (231) and is fixed to the base plate (14), the base plate (14) exhibiting a notch (273) through which the calotte (12) can actuate a touch screen (272).
15. Device according to claims 1 to 8 and 14, wherein the input element (11) and the casing (231) exhibiting flexible characteristics constitute a constructive unit.
16. Device according to claims 1 to 8, wherein the base plate (14) is equipped with a software controlled electro magnet, delivering a tactile feedback to the

actuation status of the input element (11).

17. Device according to claims 1 to 8, wherein an integrated circuit is provided underneath the input element (11), i.e. on the base plate (14) that exhibits a multitude of electrodes performing the function of contacts, the integrated circuit being equipped with two power supply contacts, an input data transmission line for configuration and three output data transmission lines for output data of x, y and z values of the corresponding spatial axes.
18. Device according to claims 1 to 8 and 15, wherein the base plate (14) lies on a display (271) with an integrated touch screen (272) and attached to it in a way that is undoable without any tools, so that the convex calotte (12) activates the touch screen (272) through a notch (273) in the base plate (14) whenever the input element (11) is activated, so that the touch screen (272) registers a specific position on the touch screen area depending on the actuation angle of the input element (11) because of the mechanical actuation by the calotte (12), and this position is transmitted for further processing, leading to a different content on the display (271) depending on the position.

19. Method for a device according to claims 1 to 18, wherein a scanning unit (16) checks the rows and columns of a contact matrix (15) for an electrical connection in a rapid sequence approx. 50 times per second and an arbitrary combination of contacts of the contact matrix (15) may be connected and the scanning unit (16) generates a bit pattern from these checks that is transmitted to a pattern recognition unit (17) for further processing.
20. Method for a device according to claim 19, wherein a pattern recognition unit (17) interprets a bit pattern received from the scanning unit (16), the bits representing closed contacts (62) of a contact matrix (15), in a way that an arithmetical average is derived from the spatial position (63) of the closed contacts and the tilt of the input element (11) along an axis is derived from this result.
21. Method for a device according to claims 18 and 20, wherein a pattern recognition unit (17) interprets a bit pattern received from the scanning unit (16), the bits representing closed contacts (62) of a contact matrix (15), in a way where the number of closed contacts is summed up to derive the flattening of a calotte (12) during the activation of the input element (11) and the applied pressure of the input element (11)

is derived from this result.

22. Method for a device according to claims 18 to 21, wherein a pattern recognition unit (17) interprets a bit pattern received from the scanning unit (16), the bits representing closed contacts (62) of a contact matrix (15), in a way that two arithmetical averages (211; 212) are derived from the spatial positions (63) of the closed contacts and the tilt of the input element (11) along two axes is derived from this result.
23. Method according to claims 19 to 22, wherein the calotte (12) of a round input element (11) closes a multitude of contacts on a contact matrix (15), that are arranged in a two-dimensional contact matrix, the controller deriving the tilt from the position of the closed contacts.
24. Method according to claims 18 to 23, wherein the calotte (12) of an input element (11) closes up to two contacts on a contact matrix (15), so that a lateral actuation closes a single contact and an actuation in the center closes two contacts.

25. Method according to claims 18 to 24, wherein to measure the activation of input elements (11) of electronic devices, the input element (11) formed like a key or a joystick can be tilted against an elastic force by an operating person, so that an electrically conductive, curved area on the underside (19) of the input element (11) touches a contact matrix (15) at various positions and thus closes one or more electrical contacts, that are evaluated by a control module consisting of a scanning unit (16) and a pattern recognition module (17), the tilt and the direction of the activation of the input element (11) being derived from the position of the closed contacts.
26. Method according to claims 18 to 25, wherein the applied pressure is derived from the number of closed contacts, the number of closed contacts being determined by a flattening of the contact medium calotte (12) on the contact matrix (15) as a result of the force applied to the input element (11).